CLAIMS

WHAT IS CLAIMED IS:

1. A modified substrate comprising:

(a) a substrate having a surface, the surface having at least one biomolecule bound thereto; and

(b) at least one nanocylinder having at least one complementary biomolecule covalently linked thereto;

wherein the at least one nanocylinder is attached to the surface through biomolecular interactions between the at least one biomolecule on the surface and the at least one complementary biomolecule on the at least one nanocylinder.

2. The modified substrate of Claim 1 wherein the at least one nanocylinder is a nanotube or nanorod.

3. The modified substrate of Claim 1 wherein the at least one nanocylinder is a carbon nanotube.

4. The modified substrate of Claim 1 wherein the at least one nanocylinder is a gold or silver nanorod.

5. The modified substrate of Claim 1 wherein the at least one biomolecule bound to the surface and the at least one complementary biomolecule covalently linked to the at least one nanocylinder are independently selected from the group consisting of oligonucleotide sequences, amino acid sequences, proteins, protein fragments, ligands, receptors, receptor fragments, antibodies, antibody fragments, antigens, antigen fragments, enzymes, and enzyme fragments.

6. The modified substrate of Claim 1 wherein the at least one biomolecule bound to the surface comprises an oligonucleotide sequence and the at

least one complementary biomolecule covalently linked to the at least one nanocylinder comprises a complementary oligonucleotide sequence.

7. The modified substrate of Claim 1 wherein the at least one biomolecule bound to the surface and the at least one complementary biomolecule covalently linked to the at least one nanocylinder form a protein-ligand pair.

8. The modified substrate of Claim 7 wherein the at least one biomolecule bound to the surface comprises avidin or Streptavidin and the at least one complementary biomolecule covalently linked to the at least one nanocylinder comprises biotin.

9. The modified substrate of Claim 1 wherein the substrate is selected from the group consisting of silicon, glass, glassy carbon, gold, and diamond thin film substrates.

10. The modified substrate of Claim 1 wherein the covalent linkage comprises the reaction product of an amine terminated nanocylinder with a molecule comprising a maleimide group.

11. The modified substrate of Claim 10 wherein the covalent linkage further comprises the reaction product of the molecule comprising the maleimide group and a thiol terminated biomolecule.

12. A method of selectively arranging nanoscale objects on a substrate comprising exposing a substrate having a surface, the surface having at least one biomolecule bound thereto, to at least one nanocylinder having at least one complementary biomolecule covalently linked thereto, wherein biomolecular interactions between the at least one biomolecule bound to the surface and the at least one complementary biomolecule covalently linked to the at least one nanocylinder attach the at least one nanocylinder to the surface.

13. The method of Claim 12, further comprising annealing the surface having the at least one nanocylinder attached thereto at a temperature sufficient to strengthen the attachment between the surface and the at least one nanocylinder.

14. The method of Claim 12 wherein the method is carried out at room temperature.

15. The method of Claim 12 wherein the at least one nanocylinder is a nanotube or nanorod.

16. The method of Claim 12 wherein the at least one nanocylinder is a carbon nanotube.

17. The method of Claim 12 wherein the at least one nanocylinder is a gold or silver nanorod.

18. The method of Claim 12 wherein the at least one biomolecule bound to the surface and the at least one complementary biomolecule covalently linked to the at least one nanocylinder are independently selected from the group consisting of oligonucleotide sequences, amino acid sequences, proteins, protein fragments, ligands, receptors, receptor fragments, antibodies, antibody fragments, antigens, antigen fragments, enzymes, and enzyme fragments.

19. The method of Claim 12 wherein the at least one biomolecule bound to the surface comprises an oligonucleotide sequence and the at least one complementary biomolecule covalently linked to the at least one nanocylinder comprises a complementary oligonucleotide sequence.

20. The method of Claim 12 wherein the at least one biomolecule bound to the surface and the at least one complementary biomolecule covalently linked to the at least one nanocylinder form a protein-ligand pair.

21. The method of Claim 20 wherein the at least one biomolecule bound to the surface comprises avidin or Streptavidin and the at least one complementary biomolecule covalently linked to the at least one nanocylinder comprises biotin.

22. The method of Claim 12 wherein the substrate is selected from the group consisting of silicon, glass, glassy carbon, gold, and diamond thin film substrates.

23. The method of Claim 12 wherein the covalent linkage comprises the reaction product of an amine terminated nanocylinder with a molecule comprising a maleimide group.

24. The modified substrate of Claim 23 wherein the covalent linkage further comprises the reaction product of the molecule comprising the maleimide group and a thiol terminated biomolecule.

25. A biomolecular sensor for sensing the presence of an analyte, the sensor comprising:

(a) a first electrode having at least one biomolecule bound thereto;

(b) a second electrode having at least one biomolecule bound thereto, wherein the first and second electrodes are separated by a gap;

(c) at least one nanocylinder having at least two biomolecules bound thereto; and

(d) a detector connected to the first and second electrodes for measuring the impedance between the first and second electrodes;

wherein the at least one biomolecule bound to the first electrode and one of the at least two biomolecules bound to the at least one nanocylinder are capable of binding the analyte between them, and further wherein the at least one biomolecule bound to the second electrode and one of the at least two biomolecules bound to the at least one

nanocylinder are capable of binding the analyte between them, wherein the at least one nanocylinder bridges the gap between the first and second electrodes and further wherein the close proximity of the nanocylinder to the electrodes produces a measurable impedance change.

26. The biomolecular sensor of Claim 25 wherein the at least one nanocylinder is a nanotube or nanorod.

27. The biomolecular sensor of Claim 25 wherein the at least one nanocylinder is a carbon nanotube.

28. The biomolecular sensor of Claim 25 wherein the at least one nanocylinder is a gold or silver nanorod.

29. The biomolecular sensor of Claim 25 wherein the at least one biomolecule bound to each of the electrodes, the at least two biomolecules bound to the at least one nanocylinder, and the analyte are independently selected from the group consisting of oligonucleotide sequences, amino acid sequences, proteins, protein fragments, ligands, receptors, receptor fragments, antibodies, antibody fragments, antigens, antigen fragments, enzymes, and enzyme fragments.

30. The biomolecular sensor of Claim 25 wherein the analyte comprises a protein and the at least one biomolecule bound to the first electrode, the at least one biomolecule bound to the second electrode, and the at least two biomolecules bound to the at least one nanocylinder comprise ligands capable of binding to the analyte.

31. The biomolecular sensor of Claim 25 wherein the analyte comprises avidin or Streptavidin and the at least one biomolecule bound to the first electrode, the at least one biomolecule bound to the second electrode, and the at least two biomolecules bound to the at least one nanocylinder comprise biotin.

32. A nanocylinder bridge comprising:

(a) a first surface having at least one biomolecule bound thereto;

(b) a second surface having at least one biomolecule bound thereto; and

(c) a nanocylinder having at least two biomolecules bound thereto, wherein one of the at least two biomolecules on the nanocylinder is bound to the at least one biomolecule on the first surface and the other of the at least two biomolecules on to the nanocylinder is bound to the at least one biomolecule on the second surface to form a bridge between the first and the second surfaces

33. The nanocylinder bridge of Claim 32 wherein the nanocylinder is a carbon nanotube.

34. The nanocylinder bridge of Claim 32 wherein each of the at least two biomolecules covalently linked to the carbon nanotube is linked to or near a different end of the carbon nanotube.

35. The nanocylinder bridge of Claim 32 wherein one of the at least two biomolecules covalently linked to the nanocylinder specifically binds to the biomolecule bound to the first surface, but not to the biomolecule bound to the second surface, and the other of the at least two biomolecules covalently linked to the nanocylinder specifically binds to the biomolecule bound to the second surface, but not to the biomolecule bound to the first surface.

36. The nanocylinder bridge of Claim 32 wherein the first and second surfaces are metal surfaces.

37. A patterned surface comprising a surface having a plurality of nanocylinders arranged thereon in a predetermined pattern, wherein the nanocylinders are attached to the surface by biomolecular interactions between biomolecules bound to the surface and their complementary biomolecules bound to the nanocylinder, and

further wherein the pattern is predetermined by the locations of the biomolecules on the surface and their complementary biomolecules on the nanocylinders.